

**What is claimed is:**

1. System for controlling exhaust emissions produced by an internal combustion engine, the system comprising:

5 an engine speed sensor sensing a rotational speed of an internal combustion engine and producing a speed signal corresponding thereto;

means for determining an altitude of said engine and producing an altitude value corresponding thereto;

10 means for determining an ambient temperature external to said engine and producing a temperature value corresponding thereto;

means for determining an output torque produced by said engine and producing a torque value corresponding thereto; and

15 a control computer determining a maximum allowable emission level as a function of said speed signal, said altitude value, said temperature value and said torque value, said computer controlling an air handling system of said engine as a function of said maximum allowable emission level such that exhaust emissions produced by said engine are limited to said maximum allowable emission level.

2. The system of claim 1 further including:

20 means for determining a first engine operating parameter different from said rotational speed of said engine, said altitude of said engine, said ambient temperature external to said engine and said output torque produced by said engine, and producing a first operating parameter value corresponding thereto; and

25 a first auxiliary emission control device (AECD) producing a first auxiliary emission level as a function of at least one of any of said engine speed signal, said altitude value, said temperature value, said torque value and said first operating parameter value;

30 wherein said control computer is operable to determine said maximum allowable emission level as a function of said engine speed signal, said altitude value, said temperature value, said torque value and said first auxiliary emission level.

3. The system of claim 2 wherein said control computer is operable to determine a reference emission level as a function of said engine speed signal, said altitude value, said temperature value and said torque value, said control computer  
5 determining said maximum allowable emission level as a maximum of said reference emission level and said first auxiliary emission level.

4. The system of claim 3 wherein said control computer includes:  
means responsive to said altitude value and said temperature value for  
10 determining an emission level cap value;  
means responsive to said engine speed signal and said torque value for determining a ratio value; and  
means for determining said reference emission level as a product of said emission level cap value and said ratio value.

15 5. The system of claim 1 further including:  
a plurality of means for determining a corresponding plurality of engine operating parameters each different from said rotational speed of said engine, said altitude of said engine, said ambient temperature external to said engine and said output torque  
20 produced by said engine, and producing a plurality of operating parameter values corresponding thereto; and

a number of auxiliary emission control devices (AECDs) producing a corresponding number of independent auxiliary emission levels each as a function of at least one of any of said engine speed signal, said altitude value, said temperature  
25 value, said torque value and said plurality of operating parameter values;

wherein said control computer is operable to determine a reference emission level as a function of said engine speed signal, said altitude value, said temperature value and said torque value, said control computer determining said maximum allowable emission level as a maximum of said reference emission level and said  
30 number of auxiliary emission levels.

6. The system of claim 5 further including an engine compression brake coupled to said engine;

wherein said means for determining an output torque of said engine includes:

5 means for determining a retarding torque produced by said engine; and

means for producing said retarding torque as said torque value when said engine compression brake is operational and for producing a commanded engine output torque value as said torque value when said engine compression brake is not operational.

10 7. The system of claim 6 wherein said means for determining an output torque of said engine further includes:

means responsive to said engine speed signal for determining a first resistance torque attributable to operation of a cooling fan driven by said engine; and

15 means for producing a motor torque value by subtracting said first resistance torque from said torque value, said motor torque value corresponding to one of said plurality of operating parameter values.

8. The system of claim 7 wherein said means for determining an output  
20 torque of said engine further includes means responsive to said engine speed signal for determining a second resistance torque attributable to operation of at least one accessory driven by said engine;

and wherein said means for producing a motor torque value is operable to produce said motor torque value by subtracting a sum of said first and second  
25 resistance torques from said torque value.

9. The system of claim 6 wherein said control computer includes:  
means responsive to said altitude value and said temperature value for determining an emission level cap value;

means responsive to said engine speed signal and said torque value for determining a ratio value; and

means for determining said reference emission level as a product of said emission level cap value and said ratio value.

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10. The system of claim 5 further including a memory coupled to said control computer;

and wherein said control computer is operable to determine an enable value as a function of said engine speed signal and said torque value, said control computer  
10 storing in said memory a rolling average of said maximum allowable emission level over a predefined time interval when said enable value is active.

11. The system of claim 10 wherein said control computer is operable to produce an active enable value when said engine speed signal is greater than an  
15 engine speed threshold and said torque value is greater than a torque threshold, said control computer otherwise producing an inactive enable value.

12. The system of claim 11 further including means for determining an NOx value indicative of NOx content of exhaust gas produced by said engine;  
20 and wherein said control computer is operable to store in said memory a rolling average of said NOx value over said predefined time interval when said enable value is active.

13. The system of claim 1 wherein said control computer includes:  
25 means responsive to said altitude value and said temperature value for determining an emission level cap value;

means responsive to said engine speed signal and said torque value for determining a ratio value; and

means for determining said maximum allowable emission level as a product of  
30 said emission level cap value and said ratio value.

14. A method of controlling exhaust emissions produced by an internal combustion engine, the method comprising:

determining a rotational speed of an internal combustion engine;

5 determining an altitude of said engine;

determining an ambient temperature external to said engine;

determining an output torque produced by said engine;

determining a maximum allowable emission level as a function of said rotational speed, said altitude, said ambient temperature and said output torque; and

10 controlling an air handling system of said engine as a function of said maximum allowable emission level such that exhaust emissions produced by said engine are limited to said maximum allowable emission level.

15 15. The method of claim 14 further including the steps of:

determining a plurality of operating parameters each corresponding to a different operating condition of said engine and each different from said rotational speed, said altitude, said ambient temperature and said output torque; and

determining a number of auxiliary emission levels each corresponding to a different auxiliary emission control device (AECD) and each as a function of at least one  
20 of any of said rotational speed, said altitude, said ambient temperature, said output torque and said plurality of operating parameters;

and wherein the step of determining a maximum allowable emission level includes determining a reference emission level as a function of said rotational speed, said altitude, said ambient temperature and said output torque, and determining said  
25 maximum allowable emission level as a maximum one of said reference emission level and said number of auxiliary emission levels.

16. System for controlling exhaust emissions produced by an internal combustion engine, the system comprising:

means for determining a first operating parameter of an internal combustion engine and producing a first operating parameter value corresponding thereto;

a first auxiliary emission control device (AECD) producing a first emission level as a function of at least said first operating parameter value; and

5 a control computer determining a maximum allowable emission level as a function of said first emission level and a reference emission level, said computer controlling an air handling system of said engine as a function of said maximum allowable emission level such that exhaust emissions produced by said engine are limited to said maximum allowable emission level.

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17. The system of claim 16 further including:

means for determining a second operating parameter of said engine different from said first operating parameter and producing a second operating parameter value corresponding thereto; and

15 a second AECD producing a second emission level as a function of at least either of said first and second operating parameter values;

wherein said control computer is operable to determine said maximum allowable emission level as a function of said first, second and reference emissions levels.

20 18. The system of claim 17 wherein said control computer includes means for determining said maximum allowable emission level as a maximum one of said reference emission level, said first emission level and said second emission level.

25 19. System for controlling exhaust emissions produced by an internal combustion engine, the system comprising:

a plurality of means for determining a corresponding plurality of different operating parameters of an internal combustion engine and producing a corresponding plurality of operating parameter values corresponding thereto;

a number of auxiliary emission control devices (AECs) each producing an independent emission level as a function of at least one of any of said plurality of operating parameter values; and

a control computer determining a maximum allowable emission level as a maximum one of a reference emission level and each of said emission levels produced by said number of AECs, said computer controlling an air handling system of said engine as a function of said maximum allowable emission level such that exhaust emissions produced by said engine are limited to said maximum allowable emission level.

20. The system of claim 19 further including:

an engine speed sensor producing an engine speed signal indicative of rotational speed of said engine;

means for determining an output torque produced by said engine and producing a torque value corresponding thereto; and

a memory coupled to said control computer;

wherein said control computer is operable to determine an enable value as a function of said engine speed signal and said torque value, said control computer storing in said memory a rolling average of said maximum allowable emission level over a predefined time interval when said enable value is active.

21. The system of claim 20 wherein said control computer is operable to produce an active enable value when said engine speed signal is greater than an engine speed threshold and said torque value is greater than a torque threshold, said control computer otherwise producing an inactive enable value.

22. The system of claim 20 further including means for determining an NOx value indicative of NOx content of exhaust gas produced by said engine;

and wherein said control computer is operable to store in said memory a rolling average of said NO<sub>x</sub> value over said predefined time interval when said enable value is active.

5           23.    A method of controlling exhaust emissions produced by an internal combustion engine, the method comprising:

          determining a plurality of operating parameters each corresponding to a different operating condition of an internal combustion engine;

          determining a number of emission levels each corresponding to a different  
10   auxiliary emission control device (AECD) and each as a function of at least one of any of said plurality of operating parameters;

          determining a maximum allowable emission level as a maximum one of a reference emission level and said number of emission levels; and

          controlling an air handling system of said engine as a function of said maximum  
15   allowable emission level such that exhaust emissions produced by said engine are limited to said maximum allowable emission level.

          24.    System for controlling exhaust emissions produced by an internal combustion engine, the system comprising:

20           means for determining a first operating parameter of an internal combustion engine and producing a first operating parameter value corresponding thereto;

          a first auxiliary emission control device (AECD) producing a first state value indicative of a first operating condition of said engine as a function of at least said first operating parameter value; and

25           a control computer controlling exhaust emissions produced by said engine by controlling an air handling system of said engine as a function of said first state value.

          25.    System for controlling exhaust emissions produced by an internal combustion engine, the system comprising:



a plurality of means for determining a corresponding plurality of different operating parameters of an internal combustion engine and producing a corresponding plurality of operating parameter values corresponding thereto;

a number of auxiliary emission control devices (AECDs) producing a corresponding number of independent state values each as a function of at least one of any of said plurality of operating parameter values; and

a control computer controlling exhaust emissions produced by said engine by controlling an air handling system of said engine as a function of said number of state values.

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26. A method of controlling exhaust emissions produced by an internal combustion engine, the method comprising:

determining a plurality of operating parameters each corresponding to a different operating condition of an internal combustion engine;

determining a number of state values each corresponding to a different auxiliary emission control device (AECD) and each as a function of at least one of any of said plurality of operating parameters; and

controlling exhaust emissions produced by said engine by controlling an air handling system of said engine as a function of said first state value.

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